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PATENT SPECIFICATION (11) 1 509 154

(21) Application No. 25705/76 (22) Filed 21 June 1976
(31) Convention Application No. 2527795
(32) Filed 21 June 1975 in
(33) Federal Republic of Germany (DE)
(44) Complete Specification published 26 April 1978
(51) INT CL² A61L 13/00 A01N 11/00
(52) Index at acceptance
A5E 1A1F3 1A1F5 1A2A 1A2D 1A2K 1A2M 1A2N1 1A2Y 1A3E 1A3F 1A5A1 1A5A2 1C14 1C15F1 1C1D 1C2E
A5B 270 27X 27Y 326 32Y 351 35Y 38Y 390 401 40Y

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(54) IODOPHOR SOLUTION

(71) We, DEUTSCHE GOLD-UND SILBER-SCHEIDEANSTALT VORMALS ROESSLER, a body corporate organised under the laws of Germany, of 9 Weissfrauenstrasse, 6 Frankfurt Main 1, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an iodophor solution.

More particularly the invention relates to an iodophor solution comprising a mixture, made up to 100% by weight with water, of 0.5 to 3% by weight of iodine, 10 to 30% by weight of phosphoric acid, an organic acid and a polymer.

Iodophor solutions are aqueous solutions of complex iodine compounds with an active iodine content of from about 0.5 to about 3% by weight which are used as disinfectants after dilution with water to the active iodine concentration adapted to the particular application envisaged.

Iodophor solutions based on different formulations are already known. They are preferably obtained from concentrates with a high active iodine content of from about 15 to about 30% by weight, the actual iodophors, by diluting admixture.

For example, iodophors and iodophor solutions based on polyvinyl pyrrolidone are already known (US-PS 2,706,701). Unfortunately, iodophors and iodophor solutions of this kind are attended by the disadvantage that a maximum of only 67% of their total iodine content is available in the form of active iodine for disinfection purposes, even when elemental iodine rather than iodine compounds is used for the production of the polyvinyl pyrrolidone iodophors, *cf.* Robert F. Cournoyer, Polymer Chemistry Edition *12*, 603—612 (1964).

Iodophors on a pure surfactant basis are also known (US-PS 2,977,315). In these iodophors, the ratio of active iodine to total iodine is generally somewhat more favourable than in the case of polyvinyl pyrrolidone iodophors. Unfortunately, they are attended by the disadvantage that they are of extremely high viscosity and, for this reason, are unsuitable for pumping. Accordingly, up to 65% of a relatively expensive viscosity-reducing agent, for example hydroxy acetic acid (according to German Patentschrift 1,171,112) has to be added to them before they are used in technical systems solely to make the products pumpable again and hence actually suitable for commercial application.

In addition, these surfactant-based iodophors, on account of their pronounced tendency towards foaming, are totally unsuitable for numerous industrial processes in which foaming is undesirable, for example in the latest methods of jet cleaning, high-pressure jet cleaning and spray-on cleaning in breweries and for this reason are not used in those processes.

Other known iodophor solutions consist of phosphoric acid, citric acid, sodium polymethacrylate, sodium xylene sulphonate, iodine, hydriodic acid and water (US-PS 3,150,096). In these iodophor solutions, the relative contents of the various components are of critical significance, for example the quantity of iodine used has to amount to between 0.5 and 3.0%. On the basis of their formulation, therefore, it is not possible to produce any iodophor concentrates of high iodine content. Accordingly, these iodophor solutions cannot be prepared by diluting corresponding high-iodine concentrates, instead each production cycle involves its own, relatively complicated iodine solubilisation process.

Another considerable disadvantage of these known iodophor solutions is that surface-active compounds (sodium xylene sulphonate) have to be used for solubilising the iodine, so that it is not possible to produce detergent-free iodophor solutions.

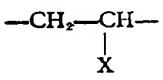
The present invention provides an iodophor solution comprising a mixture, made up to 100% by weight with water, of

a) 0.5 to 3% by weight of iodine,

b) 10 to 30% by weight of phosphoric acid,

c) 5 to 30% by weight of acetic acid, and

d) 0.5 to 20% by weight of a polymer of which the average molecular weight amounts to from 500 to 10,000 and which consists essentially of recurring units of the general formula



in which X represents

COOH in 90 to 65% of all cases,

in 10 to 35% of all cases and

CH_2OH and/or CN and/or

in 0 to 10% of all cases,

the various lateral groups being arranged in random statistical distribution.

The iodophor solutions according to the invention are uniform, of particular advantage for practical application, have a high phosphoric acid content and can readily be stirred and pumped. When diluted to the concentration in which they are used, they give disinfection solutions with very little or no tendency towards foaming.

Disinfectants are generally used to maintain or restore certain hygenic conditions in various branches of indusury and agriculture which can influence or harm the health of people either directly, for example in hospitals, or indirectly by way of products, for example by way of the products used in the food industry or in agriculture.

Accordingly, the use and effectiveness of disinfectants are not only in the interests of industry at large, they are also generally subject to public control by authorities, public/legal corporations or scientific-technical associations.

Accordingly, certain properties of iodophor solutions are actually laid down by legal stipulations, standards or official regulations.

These stipulations prescribe iodophor solutions of different composition according to local conditions and the particular applications envisaged. For example, an iodophor solution intended for use as a wound disinfectant in the sense of the known iodine tincture must have different properties from, for example, an iodophor solution intended for the high-pressure jet cleaning of brewery tanks.

A manufacturer of iodophor solutions is at an advantage when he is in a position to produce as many as possible of these various stipulated types of iodophor solutions and when he is able to use as few starting materials as possible, especially only one iodophor concentrate as iodine source, for their production.

Accordingly, a two-stage process with the production of an iodophor which can be used as universally as possible as a starting material and iodine source in the first stage and with the finishing or refining production of the various commercially interesting iodophor solutions in the second stage, would be of particular advantage.

However, the above-mentioned stipulations on the properties of iodophor solutions, which differ according to local conditions and application envisaged, have one feature in common, that is the dependence upon pH of the disproportionation reaction of the iodine in aqueous solution to form iodide/hyperidide. This disproportionation and the accompanying loss of the disinfecting activity of the iodine occur increasingly more quickly at higher pH-values of the aqueous iodine solution and begin upwards of about pH 6. Accordingly, the above-mentioned stipulations all have one requirement in common, namely that the pH-value of every iodophor disinfection solution must be in the acid pH-range and that the particular consumer (for example breweries, dairies, hospitals) must be able to prepare the iodophor disinfection solution simply by appropriately diluting the iodophor solutions with water.

Accordingly, the phosphoric acid required for stabilising the pH-value must already be present in an adequate quantity in the iodophor solutions which are marketed to the particular consumer for the preparation of iodophor disinfection solutions.

The iodophor solutions according to the invention can be produced by two fundamentally different methods.

The first method, which is generally of greater advantage from the commercial point of view, begins with the production of high-iodine, readily stirrable and pumpable, uniform, storable and detergent-free iodophor concentrates which are characterised by the fact that the iodine is actually solubilised by the copolymers used in accordance with the invention. Accordingly, preparation of the actual iodophor solutions containing from 0.5 to 3% by weight of iodine from these iodophor concentrates merely consists of a simple dilution process in which only substances that are easy to handle are used.

The particular advantage of this two-stage process for the preparation of the iodophor

solutions according to the invention is that numerous differently tailored iodophor solutions, i.e. iodophor solutions specially prepared for very different applications, can be produced relatively quickly by simple mixing and diluting processes without any need for the repeated, laborious solubilisation of iodine and without any need for the unpleasant handling of elemental iodine.

Apart from this, however, the iodophor solutions according to the invention can in principle also be directly produced in a second method from the constituents iodine, copolymer, water, acetic acid and phosphoric acid, which is even of advantage in special cases, for example for the production of disproportionately large quantities of only one certain type of iodophor solution.

In either case, the iodine solubilisation process is best carried out in a closed, corrosion-resistant, heatable and coolable stirrer-equipped vessel at internal temperatures of from about 40 to about 100°C, preferably in the range from 60°C to 80°C, and over reaction times of from 2 to 10 hours. Dissolution of the iodine can be accelerated by organic and/or inorganic iodine solvents, suitable organic iodine solvents being monohydric alcohols containing from 1 to 4 carbon atoms, preferably propanols, whilst suitable inorganic iodine solvents are hydrogen iodide and/or the alkali metal iodides and/or the alkaline earth metal iodides and/or ammonium iodide.

The above-mentioned alcohols may be used in such quantities that they make up from 0.1 to 10% by weight of the final iodophor solution, whilst the above-mentioned inorganic iodine solvents may be used in such a quantity that they make up from 0.1 to 3% by weight of the final iodophor solution.

However, no fundamental importance is attached to the above-mentioned organic and/or inorganic iodine solvents within the context of the present invention, i.e. they are not used as actual iodine solubilisers. However, by virtue of their low molecular weight character, they may be used for accelerating ("iodine carriers") the solubilisation of the iodine by the copolymers. For reasons of cost, however, their use is only advisable in cases where it is necessary for reasons of capacity to produce a high volume-time yield.

The tailoring or refining dilution of the iodophor concentrates for preparing the iodophor solutions according to the invention is distinguished by the fact that water, acetic acid and phosphoric acid are added to the iodophor concentrates, which is best carried out in a heatable or coolable stirrer-equipped vessel at temperatures in the range from 10°C to 60°C, preferably in the range from 30°C to 40°C. The way in which the various components of the mixture are combined is not critical, except that the phosphoric acid should be added last of all and in portions in order to avoid complications.

The mixing process as a whole is normally over after at most 1 hour. However, relatively high mixing temperatures in the range from 30°C to 60°C accelerate it to such a considerable extent that it is often over after only 5 to 10 minutes.

The starting materials required for producing the iodophor solutions according to the invention are summarised and characteried in the following:

Both resublimated iodine and also commercial-grade crude iodine may be used as the iodine source. However, the crude iodine should not contain any insoluble constituents which would make it necessary to filter the iodophor solutions.

The phosphoric acid is preferably used in the form of highly concentrated 65 to 85% commercial-grade acid. However, it is also possible to use dilute phosphoric acid provided that the larger quantity of water attributable to the use of dilute phosphoric acid is included in the water content of the formulation.

The acetic acid is preferably used in the form of glacial acetic acid of commercial quality. The use of dilute aqueous acetic acid solutions is governed by the same stipulation as the use of dilute phosphoric acid.

The polymers used in the iodophor solutions according to the invention have an average molecular weight of from 500 to 10,000, preferably from 1500 to 5400. The molecular weight of the polymer is determined by measuring the viscosity of a solution of 2 g of polymer in 100 ml of 0.1 M potassium chloride solution. The molecular weight may then be calculated from the viscosity coefficient using the Mark Houwink Equation. From 90 to 65% of the polymers' recurring units are derived from acrylic acid and 10 to 35% from acrolein. They may additionally contain a total of up to 10% of units derived from allyl alcohol and/or acrylonitrile and/or acrylamide. The various units are arranged in random statistical distribution within the polymer molecule.

It is preferred to use polymers of the type which only contain units derived from acrylic acid and from acrolein, i.e. pure acrolein-acrylic acid copolymers. These copolymers may be produced for example by the oxidising copolymerisation of acrolein and acrylic acid in aqueous hydrogen peroxide solution at temperatures in the range from about 60 to about 80°C. A process particularly suitable for their production is described in German Offenlegungsschrift 1,942,556.

Polymers which additionally contain the other units mentioned may be produced in the same way, but using corresponding quantities of allyl alcohol and/or acrylonitrile and/or acrylamide.

The polymers used are water-soluble and have acid equivalent weights of from about 78 to about 105.

For tailoring or for special finishing purposes, the iodophor solutions according to the invention may have added to them suitable substances whose main purpose is merely to modify the physical properties of the iodophor solutions. In their preferred form, the latter are low viscosity liquids, although they may also be converted for example into viscous iodine-containing pastes, dispersions or emulsions, in which the iodophor solutions according to the invention are present as only one of several phases.

The substances suitable for this purpose may be added both together with the diluents acetic acid and water and also individually following the addition in portions of the phosphoric acid. They may be soluble or even insoluble in the iodophor solution. In either case, they must be inert with respect to the essential ingredients according to the invention. This applies in particular to their behaviour with respect to the solubilised iodine and with respect to the phosphoric acid.

Other substances which regulate the physical properties of the iodophor solutions are anion-active wetting agents, for example the alkali metal and/or the ammonium salts and/or the free acids of sulphuric acid esters of fatty alcohols, for example sodium lauryl sulphate; sulpho fatty acids, preferably sulphosuccinic acid esters, for example sodium dihexyl sulphosuccinate; sulphonic acids of aromatic hydrocarbons, for example sodium xylene sulphonate; sulphonic acids of araliphatic hydrocarbons, for example sodium dodecyl benzene sulphonate; phosphoric acid esters, phosphonocarboxylic acids or phosphonohydrocarbons. Wetting agents such as these may be used in such quantities that they make up from 0.5 to 5% by weight of the final iodophor solution.

Suitable dilution of these wetting agent containing iodophor solutions with water gives iodophor disinfection solutions with a high wetting power and with greatly reduced interfacial tension, the interfacial tension amounting to from 30 to 45 dyn/cm (as measured by Lecompte de Nouy's method), depending upon the type and content of wetting agent.

Insoluble abrasives, such as sand, kaolin, china clay or pumice, may also be incorporated in the iodophor solutions according to the invention to form paste-like products.

Other substances which modify the physical properties of the iodophor solutions are thickeners or so-called viscosity regulators, such as pyrogenic or precipitated silicas or hydrophilic swellable polymer resins. The iodophor solutions which can be produced in this way are particularly suitable for use as disinfectants for the deep disinfection of steeply inclined, porous surfaces.

In addition, the iodophor solutions according to the invention may be incorporated in emulsions for dermatological purposes in the broadest sense which contain conventional skin care or skin protection agents, such as lanolin or its derivatives, lecithin, cholesterol, unsaturated fatty oils, hydrogenated oils, cocoa butter or similar known agents.

The iodophor solutions described in the following Examples and the products obtained from them were closely investigated by the following methods:

Uniformity testing

The uniformity of the iodophor solutions was determined by the stability test laid down in Australian Standard No. 1398—1972.

The iodophor solutions are described as uniform when the two active iodine contents, determined by potentiometric titration with sodium thiosulphate, of a sample taken from near the surface of the solution are consistent with one another within the limits of error of titration.

Viscosity measurement

The viscosities quoted were measured with rotary viscosimetres (Haake VT-01 and VT-02) at a sample temperature of 20°C.

Foaming behaviour testing

A major advantage of the uniform iodophor solutions with a high phosphoric acid content according to the invention is that non-foaming disinfection solutions can also be produced from them.

Accordingly, the careful testing, relevant to practical application, of the foaming behaviour of these disinfection solutions is particularly important in assessing the present invention.

The foaming behaviour of the disinfection solutions adjusted to an active iodine content of 20 ppm with diluting water having a hardness of 15° dH (dH=deutsche Harte=German hardness) was tested in a "dynamic test" which is briefly described in the following:

An elongate 500 ml gas washing bottle with an external diameter of 5 cm is filled with sample liquid (disinfection solution) to a level of 40 mm. A dust-free and oil-free stream of compressed air is then injected at a rate of 2.0 (±0.04) l/min through a gas inlet pipe with a frit ending just before the base of the bottle until the height of the foam mountain formed reaches a maximum for the first time.

The height of this first foam mountain maximum from the liquid surface, measured in millimetres, forms the basis for the following assessment scheme for the foaming capacity:

Scheme for assessing foaming capacity

height of first foam mountain maximum in millimetres	assessment of the foaming behaviour of the sample
under 5	non foaming
5 to 30	very weakly foaming
30 to 50	weakly foaming
50 to 150	moderately foaming
over 150	normally foaming

Foam formation in this "dynamic test" is a cyclic process in which foam forming cycles alternate with foam collapse cycles. The collapse of the foam always predominates when the foam in a zone of the foam mountain formed is no longer stable enough to withstand the weight on that zone of the overlying foam mountain.

However, the observation and evaluation of numerous of these "dynamic tests" for determining foaming capacity has shown that the wetting of the vessel walls during the rise of the first foam mountain after the beginning of the test reduces the stability of the foam so that, in the further course of the "dynamic tests", the height of the foam mountain generally does not reach the first foam mountain maximum.

Other known test methods, for example determining foaming behaviour in accordance with DIN 53 902 or the Standard Method of Test for Foaming Properties of Surface-Active Agents according to ASTM D 1173-53 (Ross-Miles Test), are totally unsuitable as a basis for assessing the present invention because, in their case, no measurable volume of foam is formed even with test solutions of the type which actually rate as moderately foaming in the "dynamic test".

The production of iodophor concentrates which are used in the following Examples for preparing the iodophor solutions according to the invention is described in the following. All the parts quoted are parts by weight.

Iodophor A

In a closed, heatable and coolable stirrer-equipped vessel with an ascending condenser and suitable feed and metering systems,

30 parts of crude iodine (98% by weight),
20 parts of potassium iodide and
50 parts of a 30% by weight aqueous solution of an acrolein-acrylic acid copolymer composed of 76% acrylic acid and 24% of acrolein groups with an average molecular weight of 4250 and an acid equivalent weight of 90, produced by the oxidising copolymerisation of acrylic acid and acrolein,

are combined and stirred for 3 to 4 hours at an internal temperature of 60°C. The entire reaction mass is then filtered through a porcelain frit (pore size G4). Only in exceptional cases is a residue left on the porcelain frit.

The filtrate (100 parts) is a deep dark red-brown coloured, homogeneous medium-viscosity liquid with an active iodine content of approximately 30% by weight.

Iodophor B

In a closed, heatable and coolable stirrer-equipped vessel with an ascending condenser and suitable feed and metering systems,

15 parts of crude iodide (98% by weight),
15 parts of isopropanol,
70 parts of a 43% by weight aqueous solution of an acrolein-acrylic acid copolymer composed of 65% of acrylic acid and 35% of acrolein groups with an average molecular weight of 1500 and an acid equivalent weight of 102, produced by the oxidising copolymerisation of acrylic acid and acrolein,

are combined and stirred for 3 to 4 hours at an internal temperature of 70°C. The entire reaction mass is subsequently filtered through a porcelain frit (pore size G4). Only in exceptional cases is a residue left on the porcelain frit.

The filtrate formed (100 parts) is a deep dark red-brown coloured, homogeneous, medium-viscosity liquid with an active iodine content of approximately 15% by weight.

Iodophor C

In a closed, heatable and coolable stirrer-equipped vessel with an ascending condenser and suitable feed and metering systems,

20 parts of crude iodine (98% by weight),
20 parts of sodium iodide,
5 parts of phosphoric acid (85% by weight),
5 parts of isopropanol,
50 parts of a 30% by weight aqueous solution of an acrolein-acrylic acid copolymer composed of 87% of acrylic acid and 13% of acrolein groups with an average molecular weight of 8500 and an acid equivalent weight of 80, produced by the oxidising copolymerisation of acrylic acid and acrolein,

are combined and stirred for 3 to 4 hours at an internal temperature of 55°C. The entire reaction mixture is subsequently filtered through a porcelain frit (pore size G4). Only in exceptional cases is a residue left on the porcelain frit.

The filtrate formed (100 parts) is a deep dark red-brown coloured, homogeneous, medium-viscosity liquid with an active iodine content of approximately 20% by weight.

The iodophor solutions and preparations described in the following were prepared using iodophors A, B and C. All the parts quoted are again parts by weight.

EXAMPLE 1

65 parts of water, 10 parts of glacial acetic acid, 10 parts of iodophor A and, in portions, 15 parts of 85% phosphoric acid are successively introduced at room temperature in that order into an open vessel with a mechanical stirrer, followed by stirring for approximately 30 minutes. The iodophor solution formed is a uniform, deep red-brown, readily stirrable liquid with an active iodine content of 3% by weight which does not form any foam either as such or in the form of a disinfection solution diluted to an active iodine content of 25 ppm and which is particularly suitable for disinfection in high pressure spraying processes using diluting water of medium hardness (up to about 20° dH).

EXAMPLE 2

20 parts of glacial acetic acid, 2 parts of sodium lauryl sulphate in the form of 96% powder, 51.3 parts of water, 6.7 parts of iodophor A and, in portions, 20 parts of 85% phosphoric acid are successively introduced in that order into a closed, heatable and coolable stirrer-equipped vessel at an internal temperature of 35°C, followed by stirring for about 5 minutes. The iodophor solution formed is a uniform, deep red-brown, readily stirrable liquid with an active iodine content of approximately 2% by weight which, in the form of a disinfection solution diluted to an active iodine content of 15 ppm, foams only very weakly, has a surface tension of 42 dyn/cm and is particularly suitable for use as a disinfection solution for disinfecting pipe systems of the type used in recirculation processes.

EXAMPLE 3

10 parts of glacial acetic acid, 10 parts of sodium dihexyl sulphosuccinate (50%, rest water and isopropanol), 61.7 parts of water, 3.3 parts of iodophor B and, in portions, 15 parts of 85% phosphoric acid are successively introduced at room temperature in that order into an open vessel equipped with a mechanical stirrer, followed by stirring for about 30 minutes. The iodophor solution formed is a uniform, red-brown, readily stirrable liquid with an active iodine content of 0.5% by weight of which the disinfection solution diluted to an active iodine content of 20 ppm has a surface tension of 31.5 dyn/cm and is particularly suitable for the machine cleaning and disinfection of bottles.

EXAMPLE 4

6 parts of glacial acetic acid, 30 parts of water, 4 parts of iodophor B and, in portions, 10 parts of 85% phosphoric acid are successively introduced at room temperature in that order into an open vessel equipped with a mechanical disperser, followed by stirring for approximately 30 minutes.

50 parts of china clay with an average grain size of 1 μm are then stirred in over a period of 1 hour by way of a vibrating metering chute.

The dispersion formed, which has an active iodine content of 0.6% by weight, is uniform and has a viscosity of 700 cP. This dispersion contains as its outer continuous phase, an iodophor solution with an active iodine content of 1.2% by weight which can be recovered from the dispersion in a yield of approximately 60% by membrane pressure filtration.

The iodine-containing dispersion is particularly suitable for use as a disinfecting cleansing agent for the treatment of skin diseases in veterinary medicine.

EXAMPLE 5

20 parts of glacial acetic acid, 5 parts of sodium dodecyl benzene sulphonate (in the form of an 80% paste), 36.7 parts of water, 13.3 parts of iodophor B and, in portions, 25 parts of 85% phosphoric acid are introduced at room temperature in that order into an open vessel equipped with a mechanical stirrer, followed by stirring for about 30 minutes. The iodophor solution formed is a uniform, deep red-brown liquid with an active content of 2% by weight which, in the form of a cleaning disinfectant solution diluted to an active iodine content of 50 ppm, has a surface tension of 33 dyn/cm, foams only weakly and is particularly suitable for use as a cleaning disinfectant for milk churns and containers on dairy farms and in dairies.

EXAMPLE 6

12 parts of glacial acetic acid, 2 parts of high molecular weight polyacrylic acid with an average molecular weight of more than 1 million, of a commercially available type (for example from B. F. Goodrich in the form of "Carbopol 940"), 22.7 parts of water, 10 parts of sodium dihexyl sulphosuccinate (50%, rest water and isopropanol), 13.3 parts of iodophor B and, in portions, 10 parts of 85% phosphoric acid are successively introduced at an internal temperature of 40°C into a closed heatable and coolable vessel equipped with a mechanical kneader and with a motor driven discharge screw below the bottom valve, followed by stirring for 5 to 10 minutes. After the reaction mass has cooled to room temperature, 30 parts of a pumice sifted and air-separated to a grain size of less than 10 μm are introduced over a period of 1 hour by

means of a distributing belt weighing machine. The dispersion formed is uniform and has a viscosity of approximately 40,000 cP. It has an active iodine content of 2% by weight and is particularly suitable for use as a disinfecting washing paste.

The homogeneous continuous phase of this dispersion consists of an iodophor solution according to the invention with an active iodine content of 2.85% by weight which can be recovered from the dispersion in a yield of 55% by membrane pressure filtration.

EXAMPLE 7

30 parts of glacial acetic acid, 30 parts of water, 10 parts of iodophor C and, in portions, 30 parts of 85% phosphoric acid are introduced at room temperature in that order into an open vessel equipped with a mechanical stirrer, followed by stirring for about 30 minutes.

The iodophor solution formed is a uniform, deep red-brown readily stirrable liquid with an active iodine content of 2% by weight which does not form any foam either as such or in the form of a disinfection solution diluted to an active iodine content of 25 ppm and which, accordingly, is particularly suitable for disinfection in high pressure spraying processes using relatively very hard diluting water (up to 40° dH).

EXAMPLE 8

20 parts of glacial acetic acid, 5 parts of sodium sulphosuccinic acid difatty alcohol ester in the form of a 75% solution in a propanol/water mixture, 35 parts of water, 10 parts of iodophor C and, in portion, 30 parts of 85% phosphoric acid, are introduced at room temperature in that order into an open vessel equipped with a mechanical stirrer, followed by stirring for about 30 minutes.

The iodophor solution formed is a uniform, deep red-brown, readily stirrable liquid with an active iodine content of 2% by weight which, as such, foams only weakly and does not foam at all in the form of a cleaning disinfectant solution diluted to an active iodine content of 25 ppm with a surface tension of 39.5 dyn/cm. Accordingly, it is particularly suitable for use as a cleaning disinfectant for spray-on cleaning and disinfection in pharmaceutical factories or breweries.

EXAMPLE 9

15 parts of glacial acetic acid, 2 parts of sodium lauryl sulphate in the form of 96% powder, 1 part of sodium dihexyl sulphosuccinate in the form of a 75% solution, 52 parts of water, 15 parts of iodophor C and, in portions, 15 parts of 85% phosphoric acid are introduced in that order into a closed heatable and coolable vessel equipped with a mechanical stirrer at an internal temperature of 35°C, followed by stirring for approximately 5 minutes.

The iodophor solution formed is a uniform, readily stirrable, deep dark red-brown solution with an active iodine content of 3% by weight which only foams weakly in the form of a cleaning disinfectant solution diluted to an active iodine content of 50 ppm with a surface tension of 32.5 dyn/cm, and which is particularly suitable for spray-off cleaning and disinfection in animal sheds, cages and poultry batteries.

EXAMPLE 10

25 parts of water, 30 parts of glacial acetic acid, 20 parts of acrolein-acrylic acid copolymer with an average molecular weight of 2000 and an acid equivalent weight of 100, 3 parts of 98% crude iodine and 2 parts of sodium dihexyl sulphosuccinate, in the form of a 75% solution, are introduced at room temperature into a closed heatable and coolable stirrer-equipped vessel with an ascending condenser and suitable feed and metering systems, followed by stirring for 3 to 4 hours at an internal temperature of 60 to 70°C. After cooling to room temperature, 20 parts of 85% phosphoric acid are added in portions. After stirring for about 30 minutes, the product is filtered through a porcelain frit (pore size G4). In general, no residue is left behind on the porcelain frit. The iodophor solution formed is a uniform, readily stirrable, deep red-brown liquid with an active iodine content of approximately 3% by weight which foams only weakly as such and does not foam at all in the form of a disinfection solution diluted to an active iodine content of 20 ppm with a surface tension of 45.2 dyn/cm. It is particularly suitable for use as a disinfection solution for the high pressure spraying disinfection and cleaning using diluting water of medium hardness (up to about 20° dH).

WHAT WE CLAIM IS:—

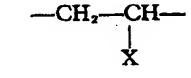
1. An iodophor solution comprising a mixture, made up to 100% by weight with water, of

a) 0.5 to 3% by weight of iodine,

b) 10 to 30% by weight of phosphoric acid,

c) 5 to 30% by weight of acetic acid, and

d) 0.5 to 20% by weight of a polymer of which the average molecular weight amounts to from 500 to 10,000 and which consists essentially of recurring units of the general formula



in which X represents
COOH in 90 to 65% of all cases,

in 10 to 35% of all cases and CH_2OH and/or CN and/or

in 0 to 10% of all cases,
the various lateral groups being arranged in random statistical distribution.

2. An iodophor solution as claimed in Claim 1, wherein it additionally contains from 0.1 to 10% by weight of a monohydric alcohol containing from 1 to 4 carbon atoms.

3. An iodophor solution as claimed in Claim 1 or 2, wherein it additionally contains from 0.1 to 3% by weight of hydrogen iodide and/or an alkali metal iodide and/or an alkaline earth metal iodide and/or ammonium iodide.

4. An iodophor solution as claimed in any of Claims 1 to 3, wherein it additionally contains from 0.5 to 5% by weight of sodium dihexyl sulphosuccinate and/or sodium lauryl sulphate and/or sodium dodecyl benzene sulphonate.

5. An iodophor solution substantially as described with particular reference to any of the Examples.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1978
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.